

NASA TECH BRIEF

Lyndon B. Johnson Space Center



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Refracting Lens System for Low-Scatter Star-Tracker: A Concept

Lenses in star-tracking navigational systems are often subject to interference from bright celestial bodies, such as the Sun and the Moon. This occurs when a star is tracked at viewing angles near a bright body. In particular, scattered sunlight collected by the tracking lens completely obscures the target star, which causes a loss of navigational reference. This problem is resolved by eliminating the excess scattered light within the tracking lens.

A report entitled "Low Scatter Lens Design/Development" discusses studies of a low-scatter lens system. Two sections cover the optical design and scattering analysis for the model of a lens system which rejects radiation.

The section discussing optical design presents general considerations that go into the selecting proper lens systems. Twenty different types of lens configurations representing three basic categories, i.e., catadioptric, reflecting, and refracting, have been compared against important criteria, such as image quality, obscuration, distortion, and the collecting area. Additional parameters include material considerations, system sensitivity factors, and ghost image locations. It is reported that the best performance characteristics are provided by a 6-element refracting lens operating at a relative aperture of $f/1.0$. The section continues with a discussion of various glass materials and their effects on a good performance. Fabrication considerations are also outlined.

The second section discusses scattering analysis. Mathematical considerations are presented to show the effects of lens imperfections on scattered light. Results indicate that the most critical parts of the system are the front elements. Lens bubbles, scratches, and surface irregularities all contribute to the scattering effect.

Following the mathematical presentation is a comparison of 6-element and 4-element lens designs. The 6-element design shows significant advantages in eliminating excess scattered light. Three appendices include further mathematical analysis and sample computations. The result of the computations are shown on computer printouts attached to the report.

Notes:

1. The report describing this study is as follows:
Low Scatter Lens Design/Development
NASA CR-134224 (N74-20322)

A copy of this report may be obtained at cost from:
Technology Application Center
University of New Mexico
Albuquerque, New Mexico 87131
Telephone: 505-277-3622
Reference: B75-10043

2. Specific technical questions may be directed to:
Technology Utilization Officer
Johnson Space Center
Code AT3
Houston, Texas 77058
Reference: B75-10043

Patent status:

NASA has decided not to apply for a patent.

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